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Antecedents and Consequences of Perceived Fit of an Interactive Digital Textbook

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ABSTRACT

Recent research suggests that the fit between a digital textbook and the learning tasks students perform with the textbook has a significant role in determining the outcomes of usage. An empirical assessment was performed on the impacts of six antecedents on perceived fit and impacts of perceived fit on utilization, satisfaction, and perceived learning performance for an interactive digital textbook used in an introductory information systems course. Analysis of survey data collected from 253 university students indicates that interactivity, reading comfort, ease of use, and searchability contribute to the perceived fit of the digital textbook. The results also confirmed perceived fit to be a significant predictor of utilization, satisfaction, and perceived learning performance. These findings suggest that students value the digital textbook as an interactive, online learning tool. To achieve better learning outcomes, university instructors should select digital textbooks that are interactive, comfortable on the eyes, easy to learn and use, and easy to search.

Keywords: Task-technology fit (TTF), Textbooks, Human-computer interaction (HCI), Instructional technology

1. INTRODUCTION

Digital textbooks (or e-textbooks) have become an increasingly popular alternative to traditional printed textbooks in higher education (Baek and Monaghan, 2013). Improvements in affordability, learning experience, and learning performance are frequently cited as benefits of digital textbooks (Acker, 2011; Rockinson-Szapkiw et al., 2013; Tang and Barnett-Ellis, 2017). However, despite the increasing prevalence and purported benefits of digital textbooks, in the larger body of research involving college students, the majority of respondents do not prefer digital textbooks over their printed counterparts (Elias, Phillips, and Luechtefeld, 2012; Dwyer and Davidson, 2013; Jesse, 2014; Walton, 2014; Mizrachi, 2015; Edmondson and Ward, 2017; Makwanya and Oni, 2019). Furthermore, studies have revealed that even students accustomed to reading digital books for non-educational purposes still prefer printed textbooks for university classes (Woody, Daniel, and Baker, 2010; Jesse, 2014; Walton, 2014), suggesting that for many university students, the lack of interest in digital textbooks can be attributed to the suitability of digital books as textbooks, rather than students' resistance to reading digital books in general. In other words, the *fit* between a digital textbook and the tasks students perform with the textbook as a learning tool is crucial in understanding university students' learning performance and attitudes toward digital textbooks. This conclusion is consistent with the main premise of the Task-Technology Fit (TTF) theory (Goodhue and Thompson, 1995; Zigurs and Buckland, 1998).

The Task-Technology Fit theory is widely accepted as a theoretical framework that facilitates understanding of how different upstream factors drive the outcomes of technology usage. Research on TTF has revealed that when a technology provides a better match with the tasks performed by the users, it leads to higher utilization and user performance (Goodhue and Thompson, 1995) and increased user satisfaction (Lin, 2012; Erskine, Khojah, and McDaniel, 2019). The importance of a good fit is well recognized for many types of technologies including digital textbooks (Gerhart, Peak, and Prybutok, 2015). According to the TTF theory, the fit of a technology is determined by various considerations salient in the specific task-technology domain (Goodhue and Thompson, 1995). Many of the fit factors proposed by Goodhue (1995) for workplace technologies may not be directly applicable to other domains. Therefore, when the theory is applied to a new context such as learning technologies, identifying and assessing the relevant factors underlying the user evaluation of overall fit is of both theoretical and practical value (Staples and Seddon, 2004).

While early digital textbooks rigidly present the contents from the printed book, current technologies enable digital textbooks to interact with the students throughout the learning process (Chesser, 2011; Bikowski and Casal, 2018). For example, students are able to not only take notes in an e-textbook, but also share notes with their classmates, encouraging collaborative learning. In addition, features such as instructor annotations in digital textbooks facilitate teacher-student interaction and enhance learning performance (Dennis et al., 2016). Quizzes and surveys embedded in e-textbook chapters afford both instructors and students the opportunity to assess learning as it occurs. For instance, some publishers' digital textbook platforms allow instructors to use embedded questionnaires to measure each student's metacognitive calibration accuracy, or, how well they can self-assess what they have learned and what gaps remain in their mastery of the material (Zhao and Ye, 2020).

A survey conducted by VitalSource Technologies, a company specializing in delivering online e-textbooks, indicates that 87% of college students believe interactive digital textbooks will help them achieve better learning performance than traditional course materials (Hetherington, 2016). However, research on digital textbook effectiveness often overlooks the importance of textbook interactivity (Margolin et al., 2013). One notable exception is Bikowski and Casal's (2018) study of students in a business English class using an interactive digital textbook custom-designed for the course. Although not quantitatively verified, based on qualitative survey data the authors attributed students' overwhelmingly positive reaction to the textbook to its interactive features such as hypertextuality (hyperlinks and multimedia contents), advanced navigation, highlighting, and notetaking.

Given the gaps discussed above and the fact that interactive textbooks from major publishers have seen increasing popularity in university courses (Roddy, 2017), the present study provides an empirical assessment of the impacts of six antecedents identified from relevant prior research on the fit of an interactive digital textbook used in an introductory information systems course. In addition, we evaluate the impact of fit on three crucial outcome variables: utilization, satisfaction, and perceived learning performance.

2. LITERATURE REVIEW

2.1 Task-Technology Fit

A computer system is a tool designed to assist its users in completing certain tasks efficiently and effectively. Recognizing the importance of the task-supporting aspect of technologies in organizations, Goodhue and Thompson (1995) and Zigurs and Buckland (1998) conceptualized task-technology fit as a research construct for evaluating the success of a technology. Task-technology fit (or simply fit) measures how well a technology serves the needs of the users, as individuals or as groups, in performing the supported tasks in an organization. As discussed in Dishaw and Strong (1998), in the most basic form, the TTF theory postulates that fit influences the outcome variables of technology adoption or usage. When a tool matches the work well, users not only improve their task performance but also have more positive attitudes toward the tool. Since the introduction of the TTF theory, researchers have examined the fit of a variety of technologies and empirically confirmed it as an antecedent to perceived or actual user performance (Staples and Seddon, 2004; Erskine, Khojah, and McDaniel, 2019), satisfaction (Lin, 2012; Erskine, Khojah, and McDaniel, 2019), and utilization (Dishaw and Strong, 1998; Staples and Seddon, 2004).

The complete form of the TTF theory also addresses the antecedents to fit. As explained by Staples and Seddon (2004, p. 19), the fit between task and technology is determined by a collection of factors, each reflecting the user perception relating to the tool's ability to satisfy a specific facet of the task to be accomplished with the tool or an expected outcome of using the tool. For example, for a shuttle bus, capacity would be a dimension of fit related to a particular facet of the task: the number of passengers to be transported. Safety, on the other hand, would be a factor representing an expected outcome of using the bus to transport people: the transportation is free of accidents for the passengers.

2.2 Task-Technology Fit of Educational Technologies

Researchers have found the TTF theory useful in understanding the use of digital technologies in higher education (Dishaw et al., 2011). In their investigation of university faculty's intention to continue using an e-learning tool, Larsen, Sørebø, and Sørebø (2009) demonstrated that by including perceived fit as an upstream independent variable, they enhanced the efficacy of their research model in predicting whether faculty intend to continue using the technology. In another higher education study, McGill and Klobas (2009) confirmed fit to be an antecedent to students' attitudes toward the use of a learning management system and their perceived learning performance. Similarly, Lin (2012) found that fit positively impacts students' satisfaction and intention to continue using an e-learning system. Most recently, Bere (2018) revealed that task-technology fit of mobile instant messaging platforms enhances student learning performance. Relating to digital textbooks, Gerhart, Peak, and Prybutok (2015) investigated the impacts of fit on university students' e-textbook usage and found fit to be a strong predictor of utilization and performance expectancy. In sum, research supports the link between the fit of educational technologies and key outcome variables.

2.3 Digital Textbook Characteristics

Digital textbooks range from those that provide an exact replica of pages from a printed book to interactive books embedded in a comprehensive learning system (Chesser, 2011). Different digital textbooks may provide vastly different features. A common outcome of studies on student preference for digital textbooks is a list of liked and disliked characteristics or features compiled from a tally of student responses. For example, Ye (2015) asked students from a systems analysis and design class to perform a feasibility analysis of a hypothetical school-wide e-textbook and e-reader adoption initiative. Among the intangible benefits identified, portability, enhanced learning, convenience of access, convenience of purchase, and increased student engagement with technology were top ranked by the student analysts. In studies on textbook features, specific functions such as notetaking, highlighting, and search capabilities are usually appreciated by the university students (Weisberg, 2011; Sloan, 2012). These studies, however, provide limited insight into how students' assessment of the overall fit of a digital textbook is formed with their perceptions related to different characteristics of the textbook and their learning tasks.

2.4 Salient Antecedents to Fit of Digital Textbooks

Identification and measurement of the fit antecedents relevant in a specific task-technology domain are considered necessary and valuable (Goodhue and Thompson, 1995). To our knowledge, the domain-specific antecedents to the fit of digital textbooks have not been discussed in the current literature.

Therefore, to identify potential antecedents, we mainly rely on prior studies on student attitudes toward digital textbooks. A review of past studies was first conducted to identify the constructs that have demonstrated salience in determining university students' attitudes toward e-textbooks in prior studies. In addition, each construct must meet the conceptual requirements for a TTF factor outlined by Staples and Seddon (2004, p. 19): it must represent either a facet of the learning tasks or an expected outcome of using digital textbooks to learn. To balance predictive power and parsimony, six antecedents were included in the research model.

Some of the traits identified in prior studies were eliminated according to the criteria set by Staples and Seddon (2004). For example, costs and convenience in purchasing (Ye, 2015), while undoubtedly beneficial to the students, are only related to the acquisition of a textbook but not to the learning tasks students perform with the book. Certain factors were excluded due to conceptual overlap with more suitable factors that have been included. Appendix 1 provides the contextualized definitions of the factors included in the research model as antecedents to task-technology fit for digital textbooks used by university students.

3. RESEARCH MODEL AND HYPOTHESES

Figure 1 presents the research model and hypotheses. Consistent with prior research (Lin, 2012; Gerhart, Peak, and Prybutok, 2015), as this study addresses student perceptions and attitudes, we describe task-technology fit as *perceived fit* in the research model and hypotheses.

3.1 Antecedents to Fit

Interactivity has long been recognized as a crucial aspect of learning technologies (Chu, 2003), as interactive features of a user interface facilitate information processing and enhance memory recall (Xu and Sundar, 2016), both of which are crucial to the learning process. Interactivity is also one of the key benefits of digital textbooks cited in student surveys (Bikowski and Casal, 2018). Specific interactive features such as highlighting, annotation, notetaking, and bookmarking are frequently mentioned as the primary reasons students use digital textbooks (Elias, Phillips, and Luechtefeld, 2012). A study of students' attitudes toward digital textbooks as learning tools confirmed that their perception of interactive learning environments is positively associated with students' satisfaction and the perceived usefulness of digital textbooks (Liaw and Huang, 2016).

Accessibility refers to the ease of accessing desired data through a computer information system (Goodhue, 1995). For digital textbooks, students also value convenient access to a book's contents (Weisberg, 2011). With the proliferation of portable devices and the increasing coverage of WiFi networks, ubiquitous access – access unconstrained by time and location – has become a key advantage to students. Students surveyed by Chu (2003) listed "available around the clock" as the top reason for using digital textbooks. Respondents in Ye (2015) also viewed "accessing the textbooks anytime anywhere" as one of the main intangible benefits of using digital textbooks. Such desire for ubiquitous access reflects students' need to perform learning tasks with their textbooks outside the constraints of classrooms or university campuses.

Goodhue (1995) included locatability to represent the "ease of determining what data is available and where," reflecting the need for users to find data within a computer information system. Likewise, students regularly use a textbook to discover information on specific topics (Nicholas, Rowlands, and Jamali, 2010). In numerous studies, students consider the ability to search within the text one of the main advantages of digital textbooks (Baek and Monaghan, 2013).

Reading is the fundamental task performed by users of any book. Compared to their printed counterparts, digital textbooks have one inherent disadvantage: physical discomfort after prolonged reading, mainly caused by eye fatigue (Kang, Wang, and Lin, 2009). Student complaints of eyestrain when reading digital textbooks dominate the negative comments in many descriptive studies (Dwyer and Davidson, 2013). Intensive reading is often performed out of necessity by university students as part of their learning experience, for example, when

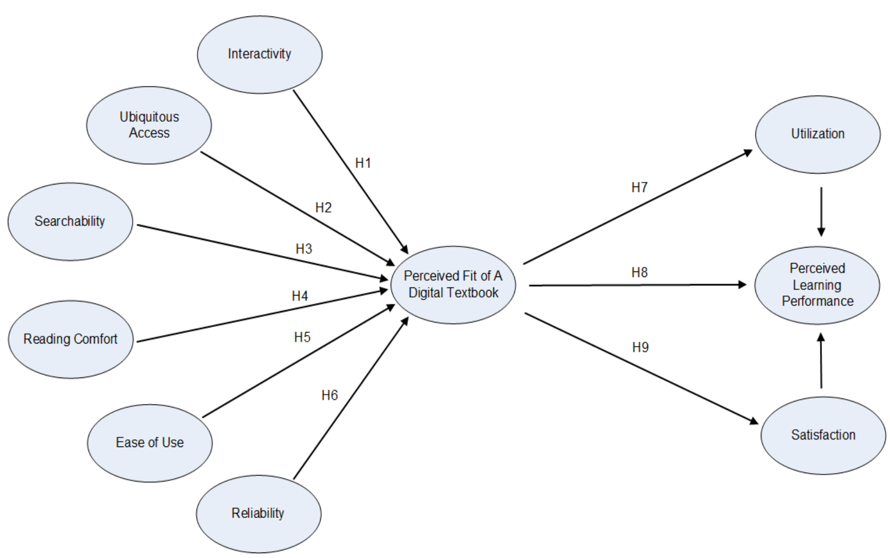

Figure 1. Antecedents and Consequences of Perceived Fit of a Digital Textbook

studying for tests. Respondents in Bikowski and Casal (2018) believe eyestrain-reducing features make a digital textbook more suitable for class reading, suggesting that a comfortable reading experience has a positive influence on the fit of a digital textbook.

The central role of ease of use in determining technology usage has been supported by copious research, including studies on university students' use of educational technologies (Nov and Ye, 2009). Specific to textbooks, ease of use also contributes to students' preference for digital textbooks (Stone and Baker-Eleveth, 2013).

Reliability is an outcome-related factor identified in Goodhue (1995). A technology suffering from frequent technical issues will hinder students' ability to accomplish learning tasks. Lee and Yau (2015) identified improving service reliability as one of the main challenges for digital textbooks. In Ye (2015), the student analysts expressed concern over losing access to a digital textbook at critical times such as before an exam and listed threats to the availability of textbooks from technical failures as the top risk factor of using digital textbooks.

H1-6: Interactivity, ubiquitous access, searchability, reading comfort, ease of use, and reliability are positively associated with the perceived fit of a digital textbook.

3.2 Consequences of Fit

Previous research has established the impact of fit on several crucial outcome variables for various types of technologies. First, perceived fit leads to greater utilization of the technology (Goodhue and Thompson, 1995). When students perceive a digital textbook to be a better fit with their learning tasks, they are more likely to use the textbook (Gerhart, Peak, and Prybutok, 2015). Student satisfaction is another important measure of success for learning technologies including digital textbooks. The better fit of a technology tool leads to a higher level of user satisfaction (Erskine, Khojah, and McDaniel, 2019). Empirical research has also confirmed the positive relationship between perceived fit and university students' satisfaction with digital learning tools (Lin, 2012).

The basic tenet of the TTF theory predicts that a higher level of fit contributes to better task performance (Erskine, Khojah, and McDaniel, 2019). Research on learning technologies has demonstrated the explanatory power of fit on university students' perceived learning performance (Lin, 2012; Bere, 2018). Perceived fit of digital textbooks has also been linked to performance expectancy (Gerhart, Peak, and Prybutok, 2015). Therefore:

H7-9: Perceived fit of a digital textbook is positively associated with utilization, satisfaction, and perceived learning performance.

Utilization and satisfaction frequently act as antecedents to performance in task-technology fit literature and the nomological networks in technology user research (DeLone and McLean, 2003; Gerhart, Peak, and Prybutok, 2015). While not the focus of the present study, we include these two relationships in the research model. Prior studies also suggest that student attitudes toward digital textbooks may vary across demographic groups (Kang, Wang, and Lin, 2009; Nicholas, Rowlands, and Jamali, 2010; Baek and Monaghan, 2013; Sun and Flores, 2013). We include age, gender, school level, and length of experience using computers as covariates for each endogenous variable in the research model.

4. METHODS

4.1 Procedure

A field survey was conducted at a regional university in the U.S. between fall 2017 and spring 2019. Respondents were students enrolled in an undergraduate information systems course required for all business majors. The class is also available to students from other colleges as a general education course. The class started adopting an interactive digital textbook from a major textbook publisher during the 2016-2017 school year. Students were required to obtain access to the digital textbook hosted on the publisher's online learning platform, although the printed version of the textbook was also available as an optional purchase. Students could access the online textbook through computers and mobile devices with Internet access. The book supported common interactive features such as advanced navigation, highlighting, and notetaking. The text was interspersed with interactive content such as hyperlinks, pop-up definitions, images, videos, and embedded self-assessment questions.

Four weeks prior to the end of each semester, an invitation to participate in the online survey was posted as an announcement on the course management system and sent as an email by instructors to the students in their respective sections. The survey was hosted on Qualtrics, an online research software provider. A random drawing for Amazon gift certificates was used to encourage participation.

From the 581 students invited, 253 usable responses were collected, yielding a response rate of 43.5%. To assess potential nonresponse bias, the demographic characteristics of the first and last 10% of respondents were compared, and no significant difference was found. Table 1 lists the descriptive statistics of the final sample.

Gender		**Computer Experience (years)**	
Male	120 (47.4%)	Mean	12.5
Female	133 (52.6%)	S.D.	5.28
Age		**School Level**	
< 20	55 (21.7%)	Freshman	18 (7.1%)
20 – 25	136 (53.8%)	Sophomore	118 (46.6%)
26 – 30	26 (10.3%)	Junior	56 (22.1%)
31 – 35	15 (6.0%)	Senior	53 (21.7%)
36 – 40	12 (4.7%)	Graduate	7 (2.8%)
> 40	9 (3.6%)	Other	1 (0.4%)

Table 1. Sample Descriptive Statistics (n = 253)

4.2 Measurements

Whenever possible, established measurements were adapted and contextualized for the present setting. Palmer (2002) and Jiang and Benbasat (2007) each published two items related to interactivity. To measure user perception of interactivity of a digital textbook, we first adapted the four items from these two studies. Two of the items – "this product provides significant user interactions" and "I am able to interact with this product" – closely resemble each other. Therefore, only the first was retained, resulting in the three-item measure listed in Appendix 2. One item from Goodhue's scale for accessibility was combined with two newly developed items to measure ubiquitous access. The scales for locatability (searchability), ease of use, and reliability from Goodhue (1995) were adapted. Reading comfort and utilization were operationalized using new items developed for this study and validated through pre-tests. The measure for satisfaction was adapted from Larsen, Sørebø, and Sørebø (2009). Three items from Sun, Flores, and Tanguma (2012) and McGill and Klobas (2009) were revised to measure perceived learning performance. All perceptual items were anchored on a 7-point Likert scale (7 = strongly agree). A panel of three researchers reviewed the scales, and two pilot studies with student respondents were conducted to refine and test the survey instruments.

The pilot studies also included two open-ended questions allowing the respondents to comment on the measurement items and provide any additional information regarding their use of digital textbooks. The answers to the first question did not reveal any major issues with the wording of the survey questions. In response to the second question, most students commented on specific features (e.g., "I wish I could easily adjust the font size in all of the e-textbooks") that map to fit factors included in the research model, or other considerations such as book price that were unrelated to task-technology fit. These comments helped confirm the selection of antecedents in the research model.

The respondents were asked to answer the survey questions according to their perceptions of the specific interactive digital textbook (called SmartBook) used in the class they were taking because students' attitudes were expected to be book-specific. In fact, one student wrote in the open comments section during the first pilot study that "I love the e-book we're using for [one class] but I hate the e-book we're using for [another class]."

5. DATA ANALYSIS AND RESULTS

We applied PLS-SEM using SmartPLS 3.2.8 (Ringle, Wende, and Becker, 2015) in measurement validation and hypotheses testing. One item for learning performance was excluded from all subsequent analyses after it displayed unsatisfactory loading in the first iteration of measurement validation.

5.1 Instrument Validation

A reliable instrument should yield consistent measures for a construct from each item. As illustrated in Appendix 3, all constructs have composite reliability (CR) above the 0.70 lower limit, indicating that all measures are reliable (Straub, Boudreau, and Gefen, 2004). A multi-item instrument also needs to measure only the construct it is intended to measure by demonstrating validity. Convergent validity refers to the convergence of the items of an instrument onto the underlying construct. Appendix 4 indicates that all measurement items have loadings above 0.60 on respective constructs, and each factor has an average variance extracted (AVE) above the 0.50 threshold, demonstrating convergent validity of the measurements (Straub, Boudreau, and Gefen, 2004).

Each measure also needs to demonstrate satisfactory discriminant validity by not correlating to unintended constructs. Appendix 4 presents the square root of the AVEs and the correlations between the constructs. For each construct, the square root of the AVE is higher than the correlation with other factors, demonstrating discriminant validity (Straub, Boudreau, and Gefen, 2004).

5.2 Hypothesis Testing

Figure 2 depicts the results of testing the structural model, including the significance levels of the path coefficients assessed with a bootstrap resampling. To predict perceived fit, the path coefficients for interactivity, searchability, reading comfort, and ease of use were significant with the expected signs, supporting H1, H3, H4, and H5. The effects of ubiquitous access and reliability were not statistically significant. Therefore, H2 and H6 were not supported by the results. The paths between fit and the three consequence variables were all significant in the predicted directions. These results support H7, H8, and H9. Furthermore, higher satisfaction is associated with higher learning performance perceived by the students, and utilization has no statistically significant effect on learning performance. Except for gender on utilization (r = -0.11, p = 0.019), none of the demographic variables had a significant effect on any of the endogenous latent variables.

Table 2 summarizes the support of the hypotheses from the PLS analysis results.

Research Hypotheses	Result
H1: Interactivity → Perceived fit	Supported
H2: Ubiquitous access → Perceived fit	Not supported
H3: Searchability → Perceived fit	Supported
H4: Reading comfort → Perceived fit	Supported
H5: Ease of use → Perceived fit	Supported
H6: Reliability → Perceived fit	Not supported
H7: Perceived fit → Utilization	Supported
H8: Perceived fit → Satisfaction	Supported
H9: Perceived fit → Perceived learning performance	Supported

Table 2. Research Hypotheses and Results

In addition, the statistical approach recommended by Podsakoff et al. (2003) was applied to assess the common method variance among the latent variables. Common method bias is not an issue in interpreting the results.

6. DISCUSSION

Results of the data analysis demonstrate that when students believe a digital textbook is interactive, easy to use, comfortable to the eyes, and easy to search, they consider the textbook to be a good fit with their learning. Subsequently, a good fit is associated with higher levels of satisfaction and utilization and better learning performance. The data did not support the hypothesized effects of ubiquitous access and reliability on perceived fit.

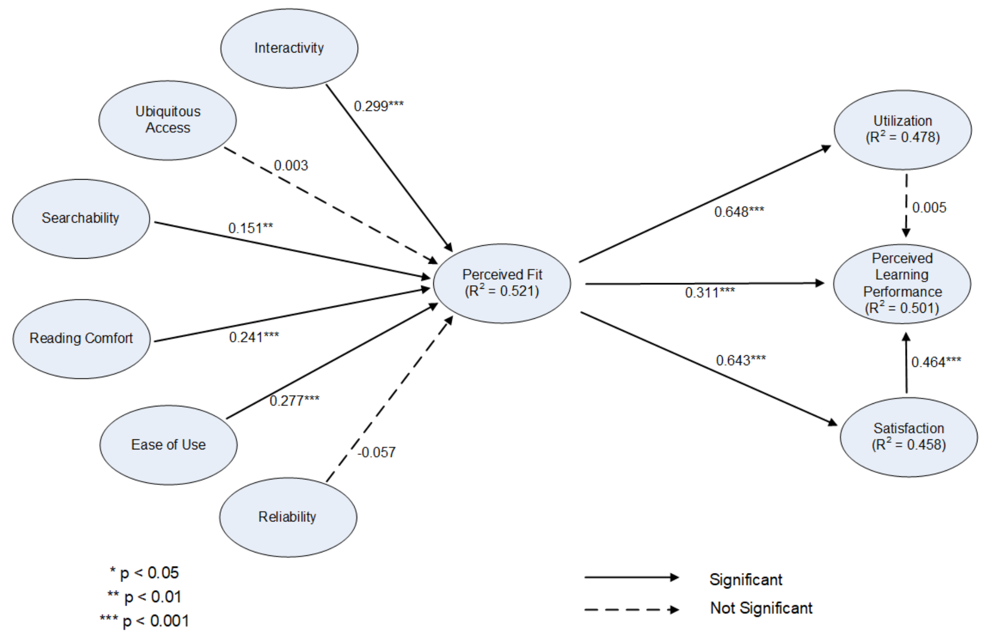

Figure 2. PLS Path Coefficients

6.1 Implications for Research and Practice

The findings of this study have significant implications for both research and practice. The broader contribution is demonstrating the need for researchers and educators to approach learning technology usage in higher education as a unique task-technology domain and to understand the importance of fit and the specific requirements for educational technologies to have a good fit with the learning tasks performed by university students. Learning is a challenging and complex process involving cognitive (knowledge), affective (emotion), and psychomotor (action) components, and hence demands students carry out a variety of tasks to achieve learning objectives. To support the learning tasks effectively, a tool must adapt to the educational setting and excel in the specific facets of fit that are crucial for student learning at the university level. When a learning tool such as a digital textbook fits well with student learning, it leads to satisfaction, utilization, and learning performance, all of which are key outcomes of a successful technology (DeLone and McLean, 2003).

Among the potential antecedents assessed, interactivity has the strongest predictive power on perceived fit. The results from the quantitative assessment agree with the findings from descriptive analyses in the literature: being interactive is one of the most significant qualities for a textbook to meet students' learning needs (Nicholas, Rowlands, and Jamali, 2010; Bikowski and Casal, 2018). The ability to interact with a computer-mediated learning environment plays a pivotal role in students' knowledge acquisition (Gilbert and Moore, 1998). The positive effects of interactivity indicate that university students view a digital textbook as an adaptive learning tool rather than a digital replica of a printed text. There was no direct parallel for interactivity among Goodhue's original TTF factors (1995, 1998), and it represents a quality pertinent to digital textbooks and e-learning tools. Future research on other digital learning technologies will need to consider the impact of interactivity on students' learning experience and outcome. Meanwhile, textbook designers and instructors should assign higher priority to interactive features in their development or selection of digital textbooks.

Discomfort caused by eyestrain when reading digital textbooks was one of the main complaints in qualitative student surveys (Bikowski and Casal, 2018), which may also explain students' avoidance of reading the whole book or entire chapters of a digital textbook (Nicholas, Rowlands, and Jamali, 2010). To the knowledge of the author, this study is among the first that employed a quantitative measure for perceived reading comfort and examined its influence on student attitudes. The finding highlights the importance for researchers to develop a greater understanding of the role of physiological discomfort in technology usage, an issue largely overlooked in the information systems literature. For digital textbook developers, considering the relatively low average score for reading comfort (mean = 3.51 on a 7 point scale) in this study, and the tendency of students to print from their digital textbooks observed in prior research (Nicholas, Rowlands, and Jamali, 2010), it is imperative to improve reading comfort for the users. Although reading comfort is arguably constrained by screen technologies, better book design through improved visual aesthetics (e.g., more graphics and multimedia content, less text, reflowable text) and greater personalization with the display settings (e.g., customizable font size and color) could potentially enhance the user experience (Chesser, 2011; Chiang, Boakye, and Tang, 2019).

As a manifestation of the locatability construct in Goodhue (1995, 1998), searchability reflects a specific learning task commonly performed by students using a textbook: discovering information on a topic in the content. With search features supported by computer software, digital textbooks are advantageous compared to printed textbooks in this regard. Even a rudimentary PDF file allows the learner to perform quick keyword searches. Not surprisingly, searchability helps a textbook be a better fit for students. This finding also aligns with the conclusions from past qualitative studies (Baek and Monaghan, 2013) and points to the significance of searchability as a key construct in future research on e-learning tools in higher education. For educators and textbook developers, improving the user friendliness and accuracy of the search feature should be prioritized.

Technology users, in general, prefer information systems that are easy to use and involve less effort. Learning requires intensive cognitive effort. Although university students tend to be young and proficient with computer technologies, ease of use still plays a role in making a digital textbook suitable for learning. Broadly, this finding suggests that an ideal learning technology should minimize the additional effort required for students to learn and use the tool.

Although ubiquitous access and reliability have been demonstrated to be desirable traits of digital textbooks in previous studies, they do not have significant associations with fit in our data. One plausible explanation is that ubiquitous access and reliability are prevalent among contemporary digital textbooks and consequently no longer function as discriminating factors in students' evaluation of different products. According to the TTF theory, there could be interactions among task, technology, and individual characteristics in determining fit. Therefore, another possibility is that some fit antecedents may be pertinent only for students in special situations that would amplify the importance of the underlying facets of fit. For example, ubiquitous access could be relevant primarily for commuter students because of their regular need to study outside the university campus. The importance of reliability in our sample may have been diminished because students still had the printed book for backup. Sufficient testing before releasing a new product to ensure its reliability is nonetheless worth recommending to textbook developers.

6.2 Limitations and Suggestions for Future Research

As an empirical research study, the scope of the present research is limited to user perceptions of only one type of technology artifact. Moreover, generalizability of the conclusions is constrained by the research setting. The data was collected from a single university located in a specific region of the U.S. All respondents were enrolled in one information systems course offered mainly to College of Business students. The composition of the respondents was not a perfectly accurate representation of the university student population across national, cultural, and academic backgrounds. Furthermore, use of the digital textbook was not completely voluntary for the respondents because purchasing the textbook as part of the online learning product was mandatory for each student. Although the TTF theory is a versatile model that applies equally to mandatory and voluntary use (Goodhue and Thompson, 1995), whether and to what degree the salience of the specific fit antecedent is moderated by voluntariness remains an unanswered question for further investigation. In summary, the strength of the relationships tested in this study should be re-examined under different empirical settings in future research.

The amount of variance explained for each endogenous variable highlights the possibility of improvement by including additional antecedents. Goodhue and Thompson (1995) cautioned that task-technology fit is only one of the determinants of utilization, and Dishaw and Strong (1998) also pointed out the existence of non-TTF factors as predictors of user performance. Factors such as cost, convenience in purchasing, and perceived environmental gains also drive students to use digital textbooks (Ye, 2015). These constructs were not included in this study because they are not directly related to students' learning tasks and were therefore not expected to be part of digital textbook task-technology fit (Staples and Seddon, 2004). To paint a full picture of students' motivation to use digital textbooks, the impacts of these factors on acceptance and utilization should be measured in future studies.

Studies have suggested that some students do not actually utilize the interactive features even when they stress the importance of interactivity of the digital textbooks (Hobbs and Klare, 2016). Such a discrepancy reflects a common pitfall of behavioral research: self-reported perceptions, attitudes, and intentions do not necessarily translate to actual behavior. The present study is not immune to this issue. Further research should aim to provide insight into students' actual use of digital textbooks.

Textbooks are also crucial components of a teacher's instructional strategies. This study only addresses the task-technology fit of digital textbooks from the students' perspective. There is much less spotlight in the literature given to the acceptance of digital textbooks by university instructors (Nicholas and Lewis, 2013). Finding the key factors that determine the fit between a digital textbook and an instructor's teaching tasks is a necessary endeavor for scholars.

7. CONCLUSIONS

Built on the literature on task-technology fit and prior research on digital textbooks, this study provides a quantitative empirical assessment of student perceptions of several factors that impact the perceived fit of a specific interactive digital textbook and the influence of perceived fit on three crucial outcome variables. In addition, the findings point to specific criteria including interactivity, reading comfort, ease of use, and ease of searching for instructors to consider when choosing the digital textbooks most conductive to student learning. These results add to the body of evidence highlighting the importance of fit in achieving desired outcomes from educational technologies.

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Appendix 1. Antecedents to Task-Technology Fit for Digital Textbooks Used by University Students

Antecedent	Contextualized Definition	Support in Selected Prior Studies
Interactivity	The textbook having interactive features	Nicholas, Rowlands, and Jamali (2010); Elias, Phillips, and Luechtefeld (2012); Sloan (2012); Baek and Monaghan (2013); Dwyer and Davidson (2013); Liaw and Huang (2016)
Ubiquitous Access	Being able to access the textbook anytime, anywhere	Goodhue (1995); Chu (2003); Nicholas, Rowlands, and Jamali (2010); Weisberg (2011); Elias, Phillips, and Luechtefeld (2012); Sloan (2012); Baek and Monaghan (2013); Ye (2015)
Searchability	Ease of searching for information within the textbook	Goodhue (1995); Chu (2003); Nicholas, Rowlands, and Jamali (2010); Weisberg (2011); Elias, Phillips, and Luechtefeld (2012); Sloan (2012); Baek and Monaghan (2013); Falc (2013)
Reading Comfort	Comfortable to read; not causing discomforts such as eye strains	Elias, Phillips, and Luechtefeld (2012); Baek and Monaghan (2013); Dwyer and Davidson (2013); Bikowski and Casal (2018)
Ease of Use	Using the textbook requires less efforts	Goodhue (1995); Baek and Monaghan (2013); Falc (2013); Stone and Baker-Eleveth (2013)
Reliability	Dependability of access to the textbook	Goodhue (1995); Lee and Yau (2015); Ye (2015)

Appendix 2. Measurements

Interactivity
SmartBook provides significant user interaction.
SmartBook provides an interface that responds to my inputs.
SmartBook provides customization.
Searchability
It is easy to search for information on a particular topic in SmartBook.
It is easy to find the information on a given subject in SmartBook.
Ubiquitous Access
I can access SmartBook anytime I need it.
I can access SmartBook anywhere I want.
I can access SmartBook quickly and easily when I need it.
Reliability
SmartBook is frequently unavailable due to device problems and crashes. (*reverse*)
I can count on SmartBook to be available when I need it.
Ease of Use
It is easy to learn how to use SmartBook.
The devices I use to access SmartBook are convenient and easy to use.
Reading Comfort
Reading SmartBook for a long period of time causes eye strain. (*reverse*)
SmartBook is as comfortable to read as printed books
I need to take frequent breaks when reading SmartBook. (*reverse*)
Perceived Fit
Overall, using SmartBook fits with the way I learn.
Using SmartBook does not fit with my learning preferences. (*reverse*)
Using SmartBook fits with my learning practice.
Utilization
I use SmartBook for all class purposes.
I use SmartBook as my primary textbook for the class.
I use SmartBook for comprehensive reading.
Satisfaction
Based on my experience, I am very contented with using SmartBook.
Based on my experience, I am very dissatisfied with using SmartBook. (*reverse*)
Based on my experience, I am delighted with SmartBook.
Perceived Learning Performance
I have been more confident in doing my assignments because of using SmartBook.
Using SmartBook has had a positive impact on my performance in the class.
I learn better with SmartBook than without it. (*dropped due to unsatisfactory loadings*)

Appendix 3. Item Means, Standard Deviations, and Factor Loadings

Item	Mean	SD	Loadings	AVE	CR
Interactivity 1	5.65	1.24	0.91	0.81	0.93
Interactivity 2	5.64	1.32	0.92		
Interactivity 3	5.15	1.42	0.87		
Ubiquitous Access 1	5.88	1.42	0.91	0.84	0.94
Ubiquitous Access 2	5.40	1.60	0.91		
Ubiquitous Access 3	5.54	1.46	0.93		
Searchability 1	5.35	1.63	0.96	0.94	0.97
Searchability 2	5.54	1.42	0.97		
Reading Comfort 1	3.40	1.75	0.87	0.78	0.91
Reading Comfort 2	3.49	1.86	0.91		
Reading Comfort 3	3.64	1.76	0.86		
Ease of Use 1	5.62	1.22	0.92	0.84	0.91
Ease of Use 2	5.61	1.34	0.91		
Reliability 1	4.99	1.97	0.95	0.93	0.96
Reliability 2	4.76	1.97	0.97		
Perceived Fit 1	4.69	1.52	0.94	0.87	0.95
Perceived Fit 2	4.67	1.73	0.93		
Perceived Fit 3	4.82	1.48	0.93		
Utilization 1	4.67	1.78	0.89	0.80	0.93
Utilization 2	4.84	2.00	0.91		
Utilization 3	4.75	1.73	0.89		
Satisfaction 1	4.83	1.72	0.95	0.91	0.97
Satisfaction 2	4.96	1.53	0.95		
Satisfaction 3	4.76	1.66	0.96		
Perceived Learning Performance 1	4.44	1.51	0.95	0.90	0.95
Perceived Learning Performance 2	4.66	1.38	0.95		

Appendix 4. Construct Correlations and Square Root of AVEs (On Diagonal)

Construct	1	2	3	4	5	6	7	8	9	10
1. Interactivity	**0.90**									
2. Ubiquitous Access	0.44	**0.92**								
3. Searchability	0.61	0.54	**0.97**							
4. Reading Comfort	0.20	0.20	0.27	**0.88**						
5. Ease of Use	0.44	0.59	0.57	0.21	**0.92**					
6. Reliability	0.24	0.34	0.27	0.43	0.25	**0.96**				
7. Perceived Fit	0.56	0.41	0.57	0.39	0.55	0.21	**0.93**			
8. Utilization	0.55	0.36	0.50	0.20	0.48	0.15	0.68	**0.90**		
9. Satisfaction	0.58	0.44	0.65	0.28	0.50	0.27	0.67	0.65	**0.96**	
10. Perceived Learning Performance	0.57	0.32	0.51	0.23	0.40	0.23	0.61	0.51	0.66	**0.95**

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